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AN EXTRAORDINARY CASE

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OF

COLOUR BLINDNESS

BY

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AN EXTRAORDINARY CASE OF
COLOUR-BLINDNESS.

It is well known that many men, and a few women, are afflicted with Daltonism, or, as it is popularly called, colour-blindness; and that this affection most usually takes the form of an inability to distinguish between green and red; although in a few cases we find yellow and blue are not distinguished, and in still fewer there seems to be no distinction between these four hues. Some time ago, however, I had the opportunity of investigating a case of Daltonism, differing from any that I can remember to have seen described; and the object of this article is briefly to recount the salient features of this case.

The victim was a lad, C— B—, who was at that time in my employment; and, as a matter of literary and scientific candour, I must confess that I afterwards discovered him to be an unscrupulous liar, whilst his abnormal deficiency in intelligence was at all times painfully present to my consciousness. A review of my experiments has, however, satisfied me that they are reliable and worth recording; for, not only was there no apparent reason why the boy should have lied in matching the colours given him, but there is also external evidence that, for at least once in his life, he was acting honestly. My first suspicion of the boy's colour-blindness was aroused by the extraordinary replies that he gave to a careless question as to the colour of a phenolphthalein solution; and this suspicion was deepened when, on being told to name several coloured objects, he hesitated a long time at a green one, and then called it, I think, either brown or red. I therefore asked him of what colour were the railway-signal-lights; and, being answered that he did not remember to have noticed them, instructed him to observe them that evening, and report progress next day—at the same time charging him not to ask anyone else's opinion on these colours. Next day he told me that the lights were green and red, whereupon I concluded that his perplexity of the previous day was only another form of his protean stupidity. Shortly afterwards, however, having sent him to the

bookshelves for a certain dull green book, I asked him its colour, and was answered, "green—red I mean," at once. I therefore told him to go to the shelves again and bring me the nearest match he could find in colour; but I could scarcely believe my eyes when he brought me a brilliant scarlet book. I then tried him with some crystals such as potassic ferrocyanide (yellow), dichromate (red), and cupric sulphate (blue), all of which he named correctly; whilst a bright blue tie which I was wearing he called "violet;" but, as will be shown later, this was apparently an error of naming only, he calling "violet" what an educated man calls blue. His colour-blindness to green was, however, brought out by a bottle of ferrous sulphate, which he said appeared to him "dirty-white." That this was a constant error was proved by the fact that, having received a remarkably large crystal of this salt (deep green in colour), I asked him of what colour it was, and, although, of course, he had no knowledge of the nature of the crystal, I was again answered by "dirty-white." Some time afterwards, however, just subsequently to the experiments about to be recorded, I again asked him the colour of this crystal, and was answered "brown;" but it should be stated that it was then standing between, and close to, large crystals of alum and dichromate. Similarly, on being asked the colour of some sage-green cards, he said "brown"—which name, as will presently appear, seems not impossibly to connote neutral tints for him.

Since, therefore, it was clear that the boy's perception of green was hopelessly bad, and not even consistent, for all the shades and tints of green—since some he named white, some brown, some red, and some apparently green—I determined to make a set of systematic experiments upon him. Now, it is very clear that any conclusions as to colour-blindness based upon the naming of colours by uneducated persons—not to say, perhaps, by the more educated, too—are radically vicious. The test must be made by having the colours matched; and only after this crucial test should the direction be given to name them.* I determined, therefore, to colour a number of strips of paper and have them matched, and subsequently named; for, although the incorrectness of such naming afford no reliable criterion as to colour-blindness, it is certainly of much importance and

* I was glad to see this point emphasised by the writer of an article on colour-blindness some years ago in *Nature*; but indeed the danger should be sufficiently obvious to anyone who is conducting experiments in this direction.

interest to ascertain what colour-names will be assigned by the colour-blind.

By way of checking the results, and guarding against error, I prepared three similar sets of these colour-slips; one set was sorted out and named at noon, one at three, and one at five, by gaslight. Since I am especially anxious to render my data as far as possible accessible to my readers, I may say that most of these slips were coloured from a box of Reeves's watercolour paints, and subjoined is a list of the names by which Reeves designates these paints, whilst a more accurate description of the colour is added in parenthesis where necessary. In addition, however, to these painted slips, it was necessary to employ several other colours, which it is not easy to so definitely describe.

List of Colours Employed.

- 1 "Prussian Blue."
- 2 "Gamboge" (Light yellow.)
- 3 "Crimson-lake." (A magnificent crimson.)
- 4 "Green." (Brightish light pea-green.)
- 5 "Light red." (Really a terra-cotta colour.)
- 6 "Bistre." (Blackish-brown.)
- 7 "Raw Sienna." (Brownish mustard-yellow.)
- 8 "Indigo."
- 9 "Vermilion." (Very dull on paper.)
- 10 "Burnt sienna." (Reddish-brown.)
- 11 "Yellow Ochre." (Hardly distinguishable from 7.)
- 12 "Vandyke-brown." (A brown.)
- 13 "Red" litmus paper. (Dull pinkish.)
- 14 "Blue" litmus paper.
- 15 "Yellow Turmeric."
- 16 Pale sageish-green.
- 17 Brilliant green.

These coloured strips I placed on a black bench away from any colour, and told the boy to sort them out into matches. I then gave him small envelopes in which to place the various sets, and told him to write the names on the packets.

Perhaps the clearest method of exhibiting the results of these experiments will be to tabulate them as below. In the three double columns are stated the results of the three experiments; in the left

hand division of each column are given the reference-number and the true name of each colour; whilst in the right hand row of each column are given the names which he assigned—those colours being bracketed together that he considered to match. For several of the browns he was quite unable to suggest any names, and these are therefore marked “unnamed.”

At 12 o'clock.

At 3 o'clock.

By Gaslight.

	TRUE COLOUR.	BOY'S NAMES.	TRUE COLOUR.	BOY'S NAMES.	TRUE COLOUR.	BOY'S NAMES.	
1	Prussian Blue	Violet ...	Prussian Blue	Violet ...	Prussian Blue	} Violet	
8	Indigo ...	Blue ...	Indigo ...	} Blue ...	Indigo ...		
14	Blue Litmus	Blue ...	Blue Litmus			Blue Litmus	Blue
12	Van.-Brown	Unnamed	Van. Brown	Unnamed	Van.-Brown	“Looks like a dirty yellowish”	
6	Bl'kish brown	Unnamed	Bl'kish Brown	Unnamed	Bl'kish Brown	} Red	
10	R'd'ish brown	Unnamed	R'd'ish Brown	} Red ...	R'd'ish Brown		
5	Terra-cotta ...	} Red; joined after great hesitation	Terra-cotta ...				Terra-cotta ...
9	Vermilion ...			Vermilion ...	Brown...		Vermilion ...
17			Brill. Green...				
3	Crimson ...	Red ...	Crimson ...	Scarlet ...	Crimson ...		
13	Pink Litmus	Red ...	Pink Litmus	Red ...	Pink Litmus	Pink	
2	Gam. Yellow	Yellow ...	Gam. Yellow	} Yellow	Gam. Yellow	} Yellow	
15	Turm. Yellow	Yellow ...	Turm. Yellow				Turm. Yellow
7	Must. Yellow	} GREEN...	Must. Yellow			Must. Yellow	} Yellow
11	Nearly same				Nearly same		
4	GREEN ...		GREEN.		GREEN ...		
16	Pale Green...	White ...	Pale Green ...	White ...	Pale Green ...	White	
17	Brill. Green...	Green ...			Brill. Green...	Green (without hesitation)	

Let us now look a little more closely into the results exhibited by this table. We may fairly neglect those tabulated in the third column, since it is clear that the artificial light greatly lessened the boy's power of discrimination—noting, however, the remarkable

exception that a brilliant green, which at three o'clock he had matched with the vermilion, he again distinguished as green by gaslight.

First of all it is clear that the boy discriminated blues, both from other colours and *inter se*, very tolerably. The Prussian blue and the indigo (on paper) were very little different; yet, after comparing them, he decided against their being alike—a discrimination which I should hardly have expected from him. The fact that he calls Prussian blue “violet,” I incline to attribute simply to wrong naming (*cf. antea*), rather than to suppose that the blue really appears violet to him: still, the point must not be overlooked. Again, taking the complementary colours, he seems to discriminate the various yellows fairly well—or at least sometimes, for, although at 3 o'clock he matched all the yellows together, yet previously, at 12 o'clock, he decided to match 7 and 11 only after comparing them, whilst he distinguished these from the gamboge and turmeric yellows,* as well as the latter *inter se*. I must, however, return to the consideration of yellows when speaking of green.

The next point to be noted is his difficulty in naming the browns. I felt considerable doubt, indeed, as to whether he had the perception or idea of brown at all; since, although he constantly applied the name to some greens, he either failed to name the browns at all (at 12 o'clock, after much thinking, he failed to name any of the three browns, although he distinguished them all as different; and at 3 o'clock he failed to name two browns) or else classed them with one or more of the reds.

Note that by gaslight he described one brown as “looking like a dirty yellowish.”

Let us next see how he fares with the reds. On the whole he distinguishes these very well indeed when they are really red. At 12 o'clock he matched the terra cotta with the dull vermilion (which were really not very markedly different) only after considerable hesitation, showing that there was really a difference apparent to him; and in each case, except by gaslight, he distinguished them from crimson; and in every case he distinguished the pink from all others. I always found him correct, too, in naming red books and red chemicals.

* The boy afterwards reminded me that anyhow he knew the turmeric was yellow, because some days previously he had been sent for some “yellow turmeric paper”: but there seems no reason at all to suppose that he would not otherwise have recognised this as yellow, since he always correctly named yellow things—at least when these were shown to him apart from any other colors.

Now, I had always understood that those afflicted with red-green colour-blindness usually saw red as green; but it seems very clear that, although this boy failed to distinguish between red and green, he always saw red as red, and the confusion was clearly due to the fact that many greens appeared red to him. I should add, however, that it is only the actual reds that he thus distinguished correctly; for, given a colour containing only a large percentage of red—as *e.g.*, anything like purple or magenta, and he was helpless; indeed, as already remarked, it was his inability to name correctly a solution coloured by phenolphthalein that first led me to suspect his colour-blindness. Another example will be adduced presently from his naming of book-covers.

And now let us pass to the greens. Three of these were used in the experiments; one, a pale green, he named “white;” and this accords with his description of ferrous sulphate as “dirty-white,” and would seem to show that many greens failed to excite any colour-sensations more pronounced than a greyish in him. One fact particularly interesting in this connection I was, however, able to note. As already stated, the colours were matched on a black-board away from any white; but in the earlier experiments I committed the oversight of afterwards handing the boy white envelopes to put the coloured slips in, telling him to write the names on the envelopes. Now, this means that, although no vitiating influence would enter into the matching, yet the white background might in a doubtful case affect the naming. This was made apparent in regard to the pale green that he called “white;” for, in the second experiment, he held it against the white envelope and, after some hesitation wrote pink. Now, pink, of course would be the complementary colour of this green. I saw my error, and thenceforth made him name the colours before giving him the envelopes; whilst, in order to make sure that I had rightly interpreted his action in naming the “pink,” I took an opportunity to send him into another room for something, and quickly replaced the pale green on the blackboard with the other colours. When in due course, he picked it up, he now named it “white”—as at 12.0 and later at 5.0. With regard to the “brightish pea-green” (4), the very first thing that he did in the first experiment was to match this with the brownish mustard-yellow. There was no shadow of doubt or hesitation about this, for, although he

compared indigo and Prussian blue before separating them, and terra cotta and dull vermilion before matching them, yet he unhesitatingly matched this green with the mustard-yellow. The other yellow (11), he added later; and, with regard to this, it seemed to me—but I could not feel at all sure thereon—that in making this match he compared 11 with the former yellows, and not with its companion green. I would call special attention to the fact that he did not match this set with the other and paler yellows (turmeric and gamboge), either in this first experiment or in that by gaslight. In the second experiment certainly he put all these yellows (and the same green) together; but it seems to me a fair inference that this was due to carelessness in sorting the colours out. Note that in the second and third experiments he named this collection “yellow,” whilst in the first he named it “green,” although the other two yellows were correctly named.

But surely his most wonderful performance is the matching and naming of the brilliant green, No. 17, which he twice named “green,” but once, by daylight, matched with the dull vermilion and called “brown”! This quite bears out his match of a scarlet book with a green one; but the fact that he twice put this colour alone, and correctly named it, would seem to show that brilliant greens were not colourless to him (unlike the pale green, No. 16), but yet that his matching and naming of them were uncertain. I suspect from a remark of his own that he had been previously aware of there being something “funny” about his eyes; and the results of these experiments suggest to me that his colour-perceptions were undergoing a natural training, the result of which was that he was already able to partially distinguish as such a brilliant green. The gradation of his green perceptions is also evidenced by the fact that pale green was each time colourless or white to him; and that an intermediate green was always classed as yellow, dirty yellow, or brown, and in these experiments each time matched with yellow, though once the set was called green. This, again, seems to me evidence of a training in colour-perception. On the whole, then we may sum up the evidence by saying that the boy was fairly normal as to the perception of actual blues, yellows, and actual reds; that pale greens were colourless to him, and deeper greens brownish or dirty—both these terms perhaps meaning greyish—whilst a very brilliant green

aroused in him distinct colour-sensations which, constitutionally, he could not distinguish from red, but which he had partially acquired the power of, somehow, distinguishing as green. One may suggest that, learning by experience, he distinguished between real reds and other people's greens as two slightly different shades or tints of one colour, just as we can educate ourselves to distinguish very fine differences of shades or tints that at first look all alike to us.

With regard to the browns, his inability to unfailingly distinguish them is evidenced by the second and third experiments, in which he matched one or two of them with one or more reds; but too much must not be made of his inability to name them, especially if the name brown had already been appropriated by him for, apparently, greyish impressions—which would account for his naming medium greens sometimes “brown,” and sometimes “dirty white.” Still, taking into account his matching brown with red, and calling the pair “red,” and dull vermilion with brilliant green and calling the pair “brown,” as well as his fondness for describing certain greens as “brown,” it is possible that brown—which, of course, contains red—was seen by him as unduly red, and that we must interpret his “brown” as dull red. In this connection it may be noted that in naming the dull-green book, as above stated, he said “brown,” but immediately corrected himself to “red.” If he really saw greens as a duller red, which, when he took the trouble, he could distinguish from true reds and called “brown,” one can easily understand that he might train himself into recognising them as green, whatever sensations they actually excited in him.

Finally I must give an example of his extraordinary inability to classify compound colours containing red—as clearly evidenced by the names he gave to the colour of phenolphthalein-solution. I showed him two book-covers, indistinguishable in colour to me, and very similar to that reddish-brown in which Spencer's “Synthetic Philosophy” is issued. These books appeared different to him, however; one he failed to name, and one he called blue! I sent him to find any bottle of chemicals that would match the latter, and he returned with some indigo-carmine,* which is a rich violetish in colour. Of this performance it seems to me prudent to offer no

* This seen by-the-bye through a somewhat blurred bottle.

explanation farther than that, as I have already shown, his eyes were quite helpless anywhere in the regions between blue and red. It should be remembered that part of the green spectrum is complementary to this non-spectral purple.

I was particularly anxious to determine whether the boy's colour-blindness were inherited or not; and, although I had no opportunity of experimenting upon the parents myself, I contrived to test them by his mediation. The boy was given two separate sets of these coloured slips, and told to make exactly the same experiments upon his parents separately, as I had made upon him. He was particularly directed to put the papers upon a dark background, to remove any white papers, cloths, saucers, etc., from the neighbourhood; and, above all, to take care that no kind of prompting or suggestion were indulged in, and that neither parent should be present while the other was sorting the colours. Next day I received from him the two packets duly sorted and named, and such an account of his procedure as implied that he had carried out his instructions, and that the results might be trusted. As to these, it will suffice to say that by the boy's father, the colours were perfectly discriminated, no two being matched at all, and in many cases admirably named; and in the mother's case there were only two matches, viz., of 2 and 15, and of 5 and 10, which are certainly very similar; so that in neither case was there the slightest colour-blindness.

Unfortunately, I found that the boy had no brothers; but, understanding that he had a sister, aged 13, I gave him another packet of slips with which to repeat the experiments upon her. The results showed the girl to be very similarly deficient in green sensations, but apparently to a less extent than her brother. Unfortunately, I was unable to obtain, as I had hoped, evidence as to the colour-blindness or otherwise of the other members of the boy's family; and his subsequent behaviour abruptly terminated my opportunities of studying the development of his apparently growing ability to distinguish green.

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